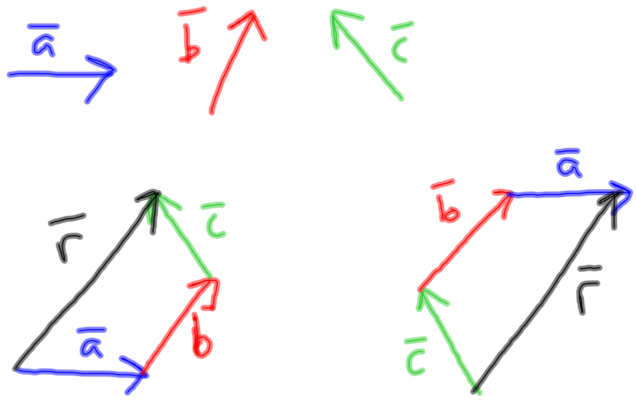
Adding Vectors:

- Graphically



- Steps:

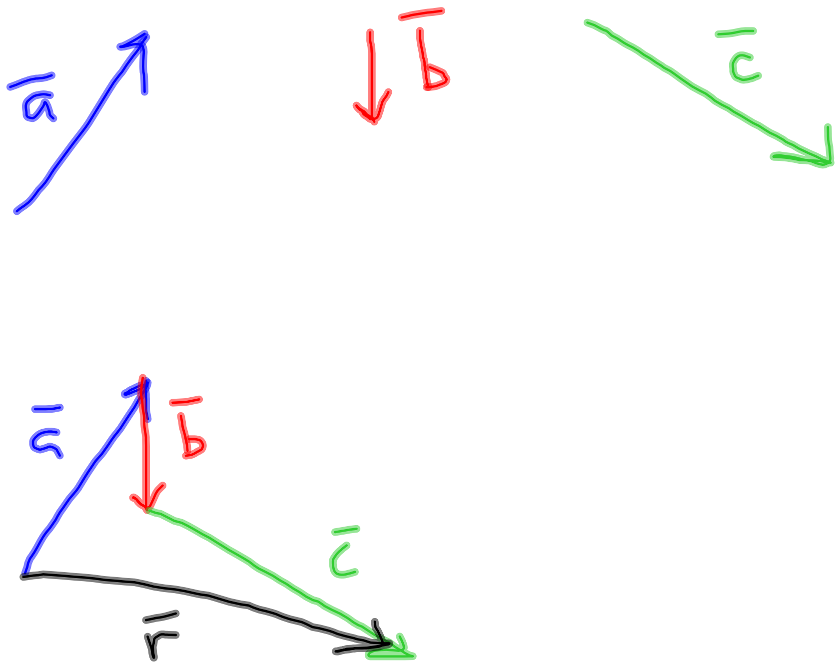
1. Move vectors so that the head of the next vector is at the tail of the previous vector.

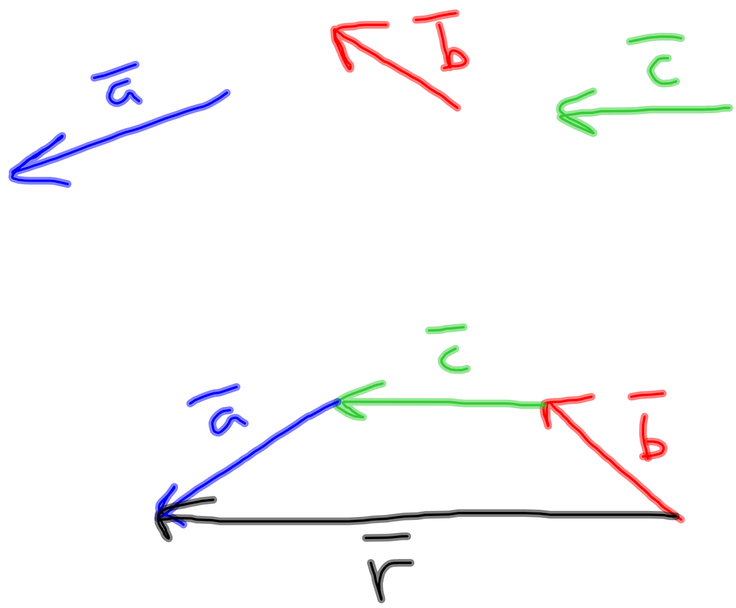
   (Choose one to start with; order of addition doesn't matter.)

   (During this process, only slide vectors; changing length or angle is not allowed.)

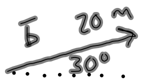
2. Resultant vector is drawn from the head of the first vector to the tail of the last vector.

Practice:





– Algebraically:



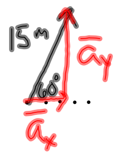
"full" vector name

$\bar{a} = 15\ m$ @ 60° North of East

$\bar{b} = 20\ m$ @ 30° North of East

* cannot just add their magnitudes because they are at different angles

So, we have break down vectors into x- and y-components using sin and cos



$\cos(60°) = \frac{a_x}{15\ m}$

$a_x = (15\ m)\cos(60°)$

$= 7.5\ m$

– Two ways to solve for a_y:

$\sin(60°) = \frac{a_y}{15\ m}$

$a_y = (15\ m)\sin(60°)$

$= 12.99\ m$

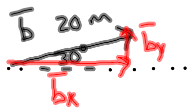
Pythagorean Theorem

$a^2 = a_x^2 + a_y^2$ $\quad a = 15\ m$

$\quad a_x = 7.5\ m$

$a_y = \sqrt{a^2 - a_x^2}$

$= 12.99\ m$

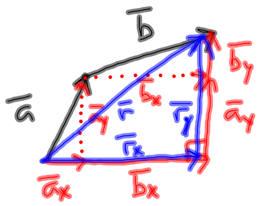


$b_x = (20\ m)\cos(30°)$

$= 17.32\ m$

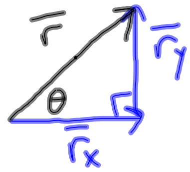
$b_y = (20\ m)\sin(30°)$

$= 10\ m$



$$r_x = a_x + b_x$$
$$= 7.5\,m + 17.32\,m$$
$$= 24.82\,m$$

$$r_y = a_y + b_y$$
$$= 12.99\,m + 10\,m$$
$$= 22.99\,m$$



magnitude of $\bar{r}$:
Pythagorean thm.

$$r^2 = r_x^2 + r_y^2$$
$$r = \sqrt{r_x^2 + r_y^2}$$
$$= \sqrt{(24.82\,m)^2 + (22.99\,m)^2}$$
$$= 33.83\,m$$

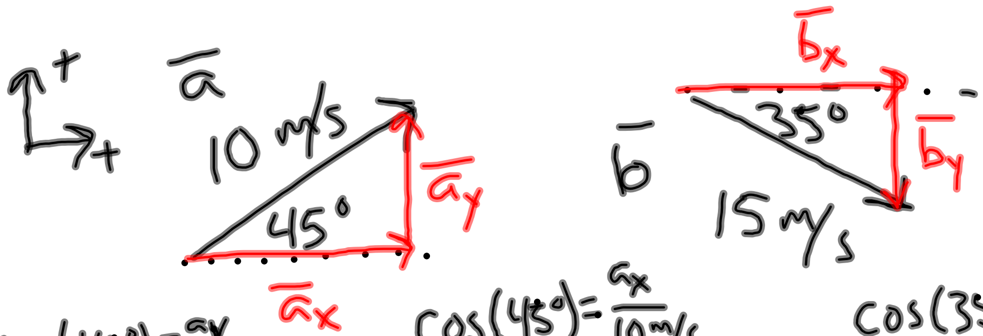
North of East

find θ:

$$\tan\theta = \frac{r_y}{r_x}$$
$$\theta = \tan^{-1}\left(\frac{r_y}{r_x}\right)$$
$$= \tan^{-1}\left(\frac{22.99\,m}{24.82\,m}\right)$$
$$= 42.8^\circ$$

$$\bar{r} = 33.83\,m \text{ @ } 42.8^\circ \text{ N of E}$$

Add the following:



$\sin(45°) = \frac{a_y}{10\ m/s}$ $\cos(45°) = \frac{a_x}{10\ m/s}$ $\cos(35°) = \frac{b_x}{15\ m/s}$

$$^{+}a_x = (10\ m/s)\cos(45°) = 7.07\ m/s$$

$$+\ ^{+}b_x = (15\ m/s)\cos(35°) = 12.29\ m/s$$

$$r_x = 19.36\ m/s$$

<u>HW:</u> p. 84: 37, 38, 39